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DIVISION OF EXHIBITS
DEPARTMENT OF EDUCATION
UNIVERSAL EXPOSITION, ST. LOUIS, 1904

MONOGRAPHS ON EDUCATION
IN THE
UNITED STATES

EDITED BY
NICHOLAS MURRAY BUTLER
President of Columbia University in the City of New York

17

SCIENTIFIC SOCIETIES AND
ASSOCIATIONS

BY
JAMES McKEEN CATTELL
Professor of Psychology in Columbia University, New York

DEPARTMENT OF EDUCATION
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Chief of Department
HOWARD J. ROGERS, Albany, N. Y.

MONOGRAPHS
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EDUCATION IN THE UNITED STATES

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President of Columbia University in the City of New York

- 1 EDUCATIONAL ORGANIZATION AND ADMINISTRATION — ANDREW SLOAN DRAPER, *President of the University of Illinois, Champaign, Illinois*
- 2 KINDERGARTEN EDUCATION — SUSAN E. BLOW, *Cazenovia, New York*
- 3 ELEMENTARY EDUCATION — WILLIAM T. HARRIS, *United States Commissioner of Education, Washington, D. C.*
- 4 SECONDARY EDUCATION — ELMER ELLSWORTH BROWN, *Professor of Education in the University of California, Berkeley, California*
- 5 THE AMERICAN COLLEGE — ANDREW FLEMING WEST, *Professor of Latin in Princeton University, Princeton, New Jersey*
- 6 THE AMERICAN UNIVERSITY — EDWARD DELAVAN PERRY, *Jay Professor of Greek in Columbia University, New York*
- 7 EDUCATION OF WOMEN — M. CAREY THOMAS, *President of Bryn Mawr College, Bryn Mawr, Pennsylvania*
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- 13 COMMERCIAL EDUCATION — EDMUND J. JAMES, *Professor of Public Administration in the University of Chicago, Chicago, Illinois*
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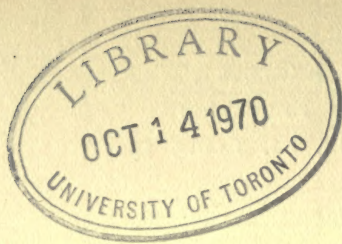
SCIENTIFIC SOCIETIES AND ASSOCIATIONS

BY

JAMES McKEEN CATTELL

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SCIENTIFIC SOCIETIES AND ASSOCIATIONS

The educational activity of a nation is not confined to its schools. Societies, journals, museums, laboratories and other institutions devoted to the advancement and diffusion of knowledge are an important part of the educational system of the United States. These agencies are on the one hand for the use of those who teach, and thus represent the most advanced educational work. On the other hand they extend the range of education widely among the people. The rapid development of the United States, its large area and scattered centers of culture, have in some respects favored and in other respects retarded the institutions with which we are concerned. They, however, show great activity and great progress, and the present review will indicate that they need not shun comparison with the similar institutions of the other great nations of the world.

SOCIETIES AND ACADEMIES

The National academy of sciences, corresponding to the Academy of sciences of Paris or the Royal society of London, was incorporated by act of congress in 1863. By the terms of this act the academy, whenever called upon by any department of the government, is required to investigate and report upon scientific questions. Thus a report has recently been presented to the department of the interior on a policy for the forested lands of the United States, and other reports have furnished the basis for important legislation. As a matter of fact the academy has not been as frequently employed by the government as was originally intended or as sound policy dictates. Established like our schools of agriculture and the mechanic arts when the country was involved in a great civil war, the academy represents a forward movement the importance of which can scarcely be

overestimated. Under the constitution of the United States the executive, legislative and judicial functions of the government are defined and separated with remarkable foresight and wisdom. But as science increases in range and in detail, expert advice and decision as a basis for legislation become more necessary. It is by no means unreasonable to look forward to a time when the scientific or advisory department of the government will rank co-ordinate with its executive, legislative and judicial departments. But before the National academy can undertake these duties it must consist, not of the most eminent, but of the most efficient men of science of the United States. In addition to its function as a scientific adviser of the government, the academy holds meetings for the reading of scientific papers, publishes reports and memoirs and administers certain funds for the promotion of research and the awarding of medals. A stated meeting is held annually at Washington in April, and migratory scientific sessions are held in the autumn. Reports are issued annually and the memoirs are now in their eighth volume. The academy administers the Bache, Watson, Draper, Smith, Gibbs and Gould funds, yielding in all an annual income of about \$6,000 for the encouragement of scientific research. The membership of the academy was originally limited to fifty, but this limitation was removed in 1870, and at present five members may be elected annually. There are now eighty-six members distributed among the different sciences as follows: Mathematics and mechanics, 3; astronomy, 9; meteorology, 1; physics, including engineering, 19; mineralogy, 2; chemistry, 14; geology, 10; paleontology, 2; zoology, 13; botany, 3; statistics, 1; anthropology, 3; physiology and pathology, 6. The academy is thus larger than the Paris academy (40 members), but smaller than the Royal society (fifteen annual elections). Fifty foreign associates may be elected; there are at present twenty-five. The present officers of the academy are: Wolcott Gibbs, president; Asaph Hall, vice-president; A. Agassiz, foreign secretary; Ira Remsen, home secretary, and John S. Billings,

treasurer. The past presidents have been A. D. Bache, 1863-1867; Joseph Henry, 1867-1878; Wm. B. Rogers, 1879-1882; O. C. Marsh, 1883-1895.

The American association for the advancement of science held its first meeting in 1848, being the continuation of the Association of American geologists and naturalists founded in 1840. The objects of the association are stated in its constitution to be "by periodical and migratory meetings, to promote intercourse between those who are cultivating science in different parts of America, to give a stronger and more general impulse and more systematic direction to scientific research, and to procure for the labors of scientific men increased facilities and wider usefulness." The association thus occupies the same field as the British association for the advancement of science (established in 1831), *L'Association française pour l'avancement des sciences* (established in 1864), *Die Versammlung deutscher Naturforscher und Aerzte* (established in 1828), and similar societies in Switzerland, Russia and other countries. All these associations have performed a useful service in bringing men of science together and in attracting the attention of the general public to scientific work. With the increasing specialization of science, the establishment of special societies and journals, and the growth of university centers, the meetings have perhaps become relatively less important than formerly. But the division into sections for the different sciences has in part met the needs of modern specialization, and there is at present a movement to arrange for the meetings of special societies in affiliation with the association.

The American association is composed of members and fellows. All interested in science are eligible to membership, while the fellows are elected from such of the members as are engaged in advancing science. There are at present 949 members and 776 fellows and in addition two patrons, one corresponding member and one honorary member. The attendance at the meetings, which are held for a week, usually in August, varies considerably with the place and other

circumstances, the average being about 400. The funds, the income of which is used to promote scientific investigation, are small, only about \$7,000. The sections into which the association is divided are as follows: A. Mathematics and astronomy. B. Physics. C. Chemistry. D. Mechanical science and engineering. E. Geology and geography. F. Zoology. G. Botany. H. Anthropology. I. Social and economic science. The executive officer of the association is the permanent secretary, of whom there have been but four, Spencer F. Baird, 1851-1854; Joseph Lovering, 1854-1873; F. W. Putnam, 1873-1898, and L. O. Howard, since 1898. The president is elected annually, and as this is regarded as one of the chief honors that can be conferred upon American men of science the list may be given: Wm. B. Rogers, W. C. Redfield, Joseph Henry, A. D. Bache, Louis Agassiz, Benjamin Peirce, James D. Dana, John Torrey, James Hall, Alexis Caswell, J. W. Bailey, Jeffries Wyman, Stephen Alexander, Isaac Lea, F. A. P. Barnard, J. S. Newberry, B. A. Gould, J. W. Foster, T. Sterry Hunt, Wm. Chauvenet, Asa Gray, J. Lawrence Smith, Joseph Lovering, J. L. Le Conte, J. E. Hilgard, William B. Rogers, Simon Newcomb, O. C. Marsh, G. F. Barker, Lewis H. Morgan, G. J. Brush, J. W. Dawson, C. A. Young, J. P. Lesley, H. A. Newton, Edward S. Morse, S. P. Langley, J. W. Powell, T. C. Mendenhall, G. Lincoln Goodale, Albert B. Prescott, Joseph Le Conte, William Harkness, Daniel G. Brinton, E. W. Morley, Edward D. Cope, Wolcott Gibbs, F. W. Putnam, Edward Orton, G. K. Gilbert, R. S. Woodward.

The American philosophical society, "held in Philadelphia, for promoting useful knowledge," was organized in 1743 through the efforts of Franklin, who was its first secretary, and later until his death its president. It was situated in Philadelphia, but was intended to represent all "the British plantations," and this national character has to a certain extent been maintained, the membership extending over the country. The intended scope of the society, strictly

utilitarian in accordance with Franklin's whole career and the general tendencies of the time, is thus defined in the original "proposal":

"That the subject of the correspondence be all new-discovered plants, herbs, trees, roots, their virtues, uses, etc.; methods of propagating them, and making such as are useful but particular to some plantations more general; improvement of vegetable juices, or ciders, wines, etc.; new methods of curing or preventing disease; all new-discovered fossils in different countries, as mines, minerals, and quarries; new and useful improvements in any branch of mathematics; new discoveries in chemistry, such as improvements in distillation, brewing, and assaying of ores; new mechanical inventions for saving labor, as mills and carriages, and for raising and conveying of water, draining of meadows, etc.; all new arts, trades and manufactures that may be proposed or thought of; surveys, maps, and charts of particular parts of the seacoasts or inland countries; course and junction of rivers and great roads, situation of lakes and mountains, nature of the soil, and productions; new methods of improving the breed of useful animals; introducing other sorts from foreign countries; new improvements in planting, gardening, and clearing land, and all philosophical experiments that let light into the nature of things, tend to increase the power of man over matter, and multiply the conveniences or pleasures of life."

The publication of transactions began in 1799 and of proceedings in 1838. 24 volumes of the former and 38 of the latter have been issued.

The American academy of arts and sciences, due largely to the efforts of Adams, was organized in Boston in 1780. Its object is said to be:

"To promote and encourage the knowledge of the antiquities of America and of the natural history of the country, and to determine the uses to which the various natural productions of the country may be applied; to promote and encourage medical discoveries, mathematical disquisitions, philosophical inquiries and experiments; astronomical, meteorological and geographical observations, and improvements in agriculture, arts, manufactures and commerce, and, in fine, to cultivate every art and science which may tend to advance the interest, honor, dignity and happiness of a free, independent and virtuous people."

As the names indicate, the Philosophical society followed the example set in Great Britain, while the American academy was influenced by French models, but their original intention and subsequent history have, in many respects, been parallel. The academy publishes memoirs in quarto, of which 16 volumes have been issued, and proceedings in octavo, now consisting of 33 volumes. Its library contains 25,000 volumes.

Societies and academies similar to the Philosophical society of Philadelphia and the Academy of arts and sciences of Boston are to be found in many of the larger cities of the United States. They have been established during the present century, many of them recently, and in their scope and influence are chiefly local or confined to a single state. These societies cover the field of the natural and exact sciences or of the natural sciences only, while special societies for different sciences have been founded in many cities. National societies have also been established for most of the sciences, and these are at the present time the most active of the scientific societies of the United States.

The New York academy of sciences, organized in 1817 as the Lyceum of natural history in the city of New York, is divided into four sections, each of which holds monthly meetings. These sections are: Astronomy and physics; geology and mineralogy; biology; anthropology, psychology and philology. The academy also holds general meetings and gives an annual reception and exhibition of scientific progress. It publishes annals in octavo and memoirs in quarto, and has a library numbering over 18,000 titles. In New York there is also a scientific alliance, including the academy and the following local societies: The Torrey botanical club, the New York microscopical society, the Linnæan society of New York, the New York mineralogical club, the American mathematical society, the New York section of the American chemical society, and the New York entomological society. Efforts are now being made for the erection of a central building for the societies composing the Scientific alliance.

Washington has recently become the chief scientific center of America, the government institutions and departments offering numerous and important positions for men of science. The **Philosophical society** was organized in 1871. This and the other societies of the city subsequently formed a joint alliance, which was transformed into the Washington academy of sciences in 1898. The societies united by

the academy are: The Anthropological society of Washington, the Biological society of Washington, the Entomological society of Washington, the Geological society of Washington, the National geographic society, the Medical society of the District of Columbia, and the Philosophical society of Washington. The academy and most of the separate societies publish proceedings.

In Philadelphia there are, in addition to the Philosophical society, several important institutions. The Academy of natural sciences, organized in 1812, possesses large endowments, a fine museum and a good library (50,000 volumes). Meetings of its different sections are held weekly, and the proceedings are now in their — volume. The Franklin institute was organized in 1824 for the promotion of the mechanic arts. Its *Journal*, published continuously since 1826, is now in its 147th volume. The institute has done much toward promoting industrial exhibitions, the development of the patent system of the United States, the laws on weights and measures, etc. It has a large library, and conducts classes and lectures. The Wagner free institute of science, organized in 1855, supports a museum and library, gives free lectures and instruction and publishes transactions.

The Boston society of natural history, founded in 1830, conducts a museum and a library, and publishes memoirs and proceedings. The Boston scientific society holds meetings partly popular in character. The Lowell lectures, endowed by Mr. John Lowell with \$250,000, are an important foundation that may be mentioned in this connection.

Other cities of the Atlantic states possess academies, organized on the general lines of those already described. The Connecticut academy of arts and sciences at New Haven, founded in 1799 on the model of the Boston academy, is the oldest of these. The Maryland academy of sciences at Baltimore dates from 1819. Local academies, often with a museum and scientific library, or scientific societies, usually of more recent development than the academies, are to be found in many cities, including Salem, Worcester, Gloucester

and Williamstown, Mass.; Portland and Augusta, Me.; Hanover and Keene, N. H.; Brattleboro, Vt.; Providence, R. I.; Hartford, Meriden, New Britain, Middletown and Bristol, Conn.; Albany, Buffalo, Rochester, Binghamton and Poughkeepsie, N. Y.; Reading and Media, Pa., and Wilmington, Del.

The conditions in the southern states before the civil war and in the years following were not favorable to the development of scientific institutions, but in recent years there has been much industrial progress, and educational and scientific institutions are increasing in number and in strength. An academy was established at Richmond, Va., in 1788, but scarcely survived its organization. There is an academy of sciences in New Orleans, La., and local societies at St. Augustine, Fla., at University, Ala., and at Chapel Hill, N. C.

The central states of the upper Mississippi valley maintain a population of high average intelligence, which is borne witness to by a great abundance of educational and scientific institutions. In several of the states—Ohio, Indiana, Wisconsin, Iowa, Minnesota, Kansas, Nebraska, Colorado—there are academies that hold winter meetings, with programs covering the different sciences. There are also academies in many cities. The Chicago academy of sciences maintains a museum and a library, publishes transactions and a bulletin and holds sectional meetings for the different sciences. There is a society of natural history at Cincinnati, Ohio, a scientific association at Detroit, Mich., and an academy of sciences at St. Louis, Mo. There are similar societies in other cities including Brookville and Terre Haute, Ind.; Elgin, Peoria and Princeton, Ill.; Davenport and Muscatine, Ia.; St. Paul, Minn., and Topeka, Kans. On the Pacific coast the California academy of sciences in San Francisco was organized in 1853. It possesses a museum and a scientific library and publishes proceedings, occasional papers, and memoirs. There are local scientific societies at Santiago and Santa Barbara, Cal., and at Tacoma, Wash., and an Alaskan society of natural history

and ethnology has been founded at Sitka. California now possesses two of the important universities of the United States, and a rapid growth of scientific interest may be expected on the Pacific coast.

The societies and academies thus briefly reviewed suffer from the specialization which the growth of modern science requires. This has indeed been met in the larger centers by a subdivision into sections, but in many cases the societies are concerned only with natural history and often in an amateur and somewhat superficial manner. The differentiation in science which has interfered with societies covering a wide field has, however, been favorable to the establishment of local and national societies devoted to a single science, while professional and technical societies with definite interests to promote have in recent years grown greatly in number and in influence.

Of these societies the National educational association should be mentioned first. Its present name was assumed in 1870, but it was established as the National teachers' association in 1857, being then the outgrowth of the American institute of instruction, organized in 1830, and other societies.

The objects of the association, according to the preamble of its constitution, are "to elevate the character and advance the interests of the profession of teaching and to promote the cause of popular education in the United States." The association has been extremely successful in attaining these ends. The annual meetings have been held in different states and in Canada, and the attendance at recent meetings tends to be as large as 10,000 members. The finances have been so administered that a large permanent endowment has been secured, and the annual volumes of the *Proceedings* contain papers and discussions of great educational interest and value. Until 1870 topics were discussed before the whole association as a body, but subsequently special departments have been organized, including school superintendence, normal schools, kindergarten instruction, elementary

education, secondary education, higher education, industrial education, art education, music education, and a national council of education. The council of education, consisting of sixty members elected from the association, has been the author of many important documents and reports.

There are in nearly every state and in many counties associations of teachers devoted to the improvement of the schools and the professional interest of the members. Meetings are usually held once a year, and are largely attended. There are also numerous local societies, which perform important scientific, professional and social functions. It cannot be expected that the general level of the papers and discussions before these societies should be much above the average of those who attend the sessions. But teaching is gradually becoming a profession co-ordinate with medicine, law and theology, and the numerous educational societies are contributing toward this end.

The physicians of the United States have numerous societies, which in part perform the functions of trades unions for the profession, and in part contribute to the advancement of medical science and practice. The American medical association holds an annual migratory meeting, and publishes an important monthly journal. The Association of American physicians and the American academy of medicine are also national associations covering the whole field of medicine. There are further national societies for different departments — neurology, ophthalmology, otology, gynæcology, dermatology, pediatry, climatology, etc. Then there are societies for different sections of the country, and nearly every state of the union has a special medical society holding an annual meeting. There are also numerous local societies which meet in sections and at frequent intervals. The Academy of medicine in New York city, and the College of physicians of Philadelphia, for example, own fine buildings and administer large libraries.

In addition to an American bar association there are several state and local societies of lawyers. These sometimes

maintain a library, but their objects are strictly professional, so that they can scarcely be regarded as scientific societies even in the widest interpretation of the term. This holds also for the congresses and assemblies of different religious denominations. They are chiefly occupied with executive work and matters of discipline and but rarely discuss subjects that contribute to the advancement or diffusion of knowledge.

On the other hand the societies of technical science, while to a certain extent concerned with the professional interests of their members, are chiefly devoted to research. The societies are large in membership and in influence, representing one of the most important scientific developments of the present time and of the United States.

The American chemical society was the outgrowth of a meeting held in 1874 to celebrate the centennial of the discovery of oxygen. The society was organized in 1876, and now holds two general meetings annually, one during the Christmas holidays and one in the summer in connection with the American association. It maintains a monthly journal, and has recently established in New York city a club house in which its library is deposited. Local sections of the society, holding frequent meetings throughout the year, have been established in New York, Washington, Chicago, Rhode Island, Cincinnati, the Lehigh Valley, New Orleans, Nebraska, North Carolina and Columbus.

The American society of civil engineers is the oldest of the societies of applied science, having been organized and incorporated in 1852. It has headquarters in New York city and publishes monthly *Transactions*. The American institute of mining engineers was organized in 1871, the American society of mechanical engineers in 1880, and the American institute of electrical engineers in 1884. Each of these societies has a large membership, publishes transactions, and exercises an important influence on the development of applied science. In addition to these national societies there are in the United States numerous other

technological associations. The Tekniker Verein of Washington is the headquarters of the National association of German-American technologists with nine branches. We have an Engineering association of the south, a Technical society of the Pacific coast, a Western society of engineers, and many local societies.

All the leading sciences now have national organizations. The American mathematical society, established as the New York mathematical society in 1888, publishes a monthly *Bulletin* and *Quarterly transactions*, holds regular meetings in New York and in Chicago, and a migrating meeting in the summer. A conference of astronomers and astrophysicists was held on the occasion of the dedication of the Yerkes observatory in 1897, and has since been made an annual meeting. A physical society is now in course of organization. An American metrological society was established in 1873 and has exerted much influence toward the adoption of the metric system and the definition of units of measure. The American chemical society has already been described.

The Geological society of America was organized in 1888. It holds two annual meetings and publishes a *Bulletin*. The American geographical society of New York and the National geographic society of Washington, though from one point of view local, are national in their influence. Each publishes a journal, and does much to arouse popular interest in geographical exploration. The New York society has a new building in course of erection.

The American society of naturalists, organized in 1883, largely with a view to the discussion of educational questions, holds winter meetings during the Christmas holidays, which serve as a center for several societies devoted to the natural sciences. These are the Association of American anatomists, the Society for plant morphology and physiology, the American morphological society, the American physiological society, the American psychological association, the American folklore society, and section H, anthro-

pology, of the American association for the advancement of science. Some two hundred papers are annually presented before these affiliated societies representing a high level of scientific research. The American ornithologists' union, organized in 1883, always has a valuable program for its annual meetings, and publishes a quarterly journal—*The Auk*. The American microscopical society (1878) and the American entomological society (1859) complete the list of national scientific societies, but there are in addition to these a large number, more local in character. The Astronomical society of the Pacific, organized in 1889, issues a bi-monthly *Publication*. There are in San Francisco two geographical societies and Philadelphia has an important geographical society. Local clubs, especially of botany, ornithology and microscopy are widely scattered over the country. They are often somewhat amateur in character, but useful in many ways.

In history and economics there are several national societies of importance. The American historical association, organized in 1884, issues reports and papers. Its principal office is at Washington, but it holds migratory meetings. The American economical association (1885), and the American academy of political and social science (1889), are both active associations issuing important publications. There are further to be mentioned the American statistical association and the American social science association. The Massachusetts historical society, organized in 1791 and incorporated in 1794, is one of the oldest historical societies in the world. The New York historical society was organized in 1804, and the Historical society of Pennsylvania in 1824. Historical societies, chiefly for the collection of material relating to a single state, county or locality, are very numerous. There are also many genealogical, memorial and patriotic societies which scarcely fall within the limits of this review.

The Archæological institute of America has sent out various expeditions and published the results. The American antiquarian society, organized in 1812 in Worcester,

Mass., has had a long and useful career. There is an American numismatic and archæological society and several local archæological and antiquarian societies.

In philology the American philological association (1869), the American oriental society (1842), the American dialect society (1889), the American folklore society (1888), the Modern language association of America (1883), and the Spelling reform association (1876), are the most important societies. In this connection may also be mentioned the American library association, although its objects are largely professional. We have an American Dante society, and numerous local Shakespeare clubs and literary societies.

In the fine arts there are important associations, such as the National academy of design, in New York, and the Pennsylvania academy of the fine arts in Philadelphia, which hold annual exhibitions. A National league of mineral painters was organized in 1892.

JOURNALS

The dispersion of American students over a great area and the lack of a single center of culture, such as foreign nations possess in London, Paris and Berlin, gives especial importance to journals as a means of intercommunication. The differentiation of science in recent years has lead to the rapid multiplication of special journals, but at the same time increases the need of journals that will keep the sciences in touch with each other.

The American journal of science was the earliest of our scientific journals, having been established at Yale university by the elder Silliman in 1818. *The Journal of the Franklin institute* began as the *American mechanic's magazine* in 1825; other technical journals were established and various scientific journals came and went, but the *American journal of science* for fifty years sufficed for the publication of the scientific work of the country. The *American naturalist* was founded by Professors Packard, Morse, Hyatt and Putnam in 1867. *The Popular science monthly*

was begun in 1872. Dr. A. Graham Bell and the late Gardiner G. Hubbard established *Science*, a weekly journal, in 1883. Numerous journals devoted to special sciences have recently been founded, largely under the auspices of universities, Johns Hopkins and Chicago accomplishing the most in this direction.

A representative educational journal was lacking until the establishment of the *Educational review* by Professor Nicholas Murray Butler in 1891. We have some four hundred medical journals, only a few of which surpass mediocrity. Among literary journals the *Atlantic monthly* has had the most honorable history, while the *Nation*, including politics in its scope, has been an influential weekly journal. *The North American review* and *The Forum* do not equal the journals of Great Britain and France devoted to literature and public affairs. On the other hand, the monthly illustrated journals have been extremely successful and have contributed much to the popularization of literature, art and science.

The more important of the scientific and learned journals of the United States (proceedings of societies and technical and trade journals being omitted), are as follows :

General science

American journal of science (1818). E. S. Dana. New Haven, monthly.

Science (1883). J. McKeen Cattell. New York, weekly.

Appletons' popular science monthly (1872). W. J. Youmans. New York, monthly.

Scientific American (1846). New York, weekly.

Scientific American supplement (1876). New York, weekly.

Mathematics

American journal of mathematics (1878). S. Newcomb. Baltimore, quarterly.

Bulletin of the American mathematical society (1893). Thomas S. Fiske, F. N. Cole, Alexander Ziwet, Frank Morley, E. O. Lovett. New York, monthly.

Annals of mathematics (1884). Ormond Stone, H. S. White, W. E. Byerly, H. F. Osgood, Maxime Bocher. Cambridge.

Astronomy

Astronomical journal (1849). Seth C. Chandler. Cambridge.

Astrophysical journal (1895). George E. Hale and James E. Keeler. Chicago, monthly.

Popular astronomy (1893). Wm. W. Payne. Northfield, Minn., monthly.

Physics

Physical review (1893). E. L. Nichols, Ernest Merritt, Frederick Bedell. New York, monthly.

Terrestrial magnetism and atmospheric electricity (1895). L. A. Bauer. Baltimore, quarterly.

Chemistry

American chemical journal (1879). Ira Remsen. Baltimore, monthly.

Journal of the American chemical society (1887). Edward Hart. Easton, Pa., monthly.

Journal of physical chemistry (1896). W. D. Bancroft, J. E. Trevor. Ithaca, N. Y., nine numbers.

Geology and geography

American geologist (1888). N. H. Winchell. Minneapolis, monthly.

Journal of geology (1893). T. C. Chamberlin. Chicago, semi-quarterly.

National geographic magazine (1888). John Hyde. Washington, monthly.

Bulletin of the American geographical society (1892). Librarian. New York, five numbers.

Natural science

American naturalist (1867). Boston, monthly.

Biological bulletin (1897). C. O. Whitman. Boston, irregular.

Zoology

Journal of morphology (1887). C. O. Whitman. Boston, irregular.

The Auk (1876). J. A. Allen. New York, quarterly.

Botany

Bulletin of the Torrey botanical club (1870). L. M. Underwood. New York, monthly.

Botanical gazette (1876). John M. Coulter, Charles R. Barnes, J. C. Arthur. Chicago, monthly.

Physiology and pathology

American journal of physiology (1898). Wm. T. Porter. Boston, monthly.

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MUSEUMS AND OTHER SCIENTIFIC INSTITUTIONS

The Smithsonian institution at Washington is unique both in its history and in its objects. James Smithson, an Englishman, who died at Genoa in 1829, left a will containing the clause, "In the case of the death of my said nephew without leaving a child * * * I then bequeath the whole of my property * * * to the United States of America, to found at Washington, under the name of the Smithsonian institution, an establishment for the increase and diffusion of knowledge among men." In 1838 the United States government received somewhat more than \$500,000 in accordance with the terms of this will. The character of the institution that should be established with the bequest was for eight years the subject of discussion in congress. The final result exactly fulfilled the intention of Smithson; an institution was founded for "the increase and diffusion of knowledge," which has exercised an important influence on the development of science in America.

The board of regents of the institution has wisely left the administration to the secretary, who appoints all officers and is responsible for expenditures. They have been particularly fortunate in the secretaries they have selected, Joseph Henry, 1846-1878; Spencer Fullerton Baird, 1878-1887, and Samuel Pierpont Langley since 1887. The scope of the institution was outlined by the first secretary, and its policy was shaped by him during a long administration. Henry believed that the Smithsonian institution should not continue to do anything that could be done equally well by other agencies, and it was largely through this wise policy and under the guidance of the institution that the government of the United States has undertaken to develop the

resources of the country and advance science to a greater degree than any other nation. On these objects the sum of over \$8,000,000 is spent annually, and over 5,000 officers are employed.

The library of the Smithsonian institution was early transferred to the library of congress, and was the most important step towards making a great national library. The museum, though still administered by the institution, is now supported by the government. The meteorological observations, reported with the aid of the electric telegraph, to which Henry's researches had so largely contributed, were transferred to a separate bureau, now under the department of agriculture. The geological survey and the coast and geodetic survey, the beginnings of which were chiefly due to President Jefferson, were aided by the institution. They have now become well established as separate departments, while the bureau of American ethnology has been placed under the administration of the institution. The work on the fisheries, begun by Secretary Baird, has developed into a separate commission. Adams strenuously urged the application of the income from Smithson's bequest to the establishment of a national observatory, and the naval observatory founded at the time may perhaps be regarded as an indirect result of this bequest, while an astrophysical observatory has been made under Secretary Langley a part of the institution. When the National zoological park was established in 1889 it was placed under the direction of the institution.

The primary objects of the institution have been largely carried out by its publications, which include annual reports, contributions to knowledge and miscellaneous collections, in addition to the publications of the National museum and the Bureau of American ethnology. The publications now number 250 volumes, and by exchange the library, amounting to some 400,000 volumes and pamphlets, has been chiefly collected. The system for exchange of publications now corresponds with some 25,000 libraries and individuals,

and acts as a medium of exchange for the government and other institutions as well as for the publications of the institution.

The building of the institution was erected from the income of the bequest, and further savings from the income amount to \$100,000. By a gift of \$200,000 from Thomas G. Hodgkin in 1891 and smaller bequests, the funds of the institution now amount to nearly one million dollars. These are deposited with the government which guarantees an income of 6 per cent. The Hodgkin's fund is, in part, for investigations of the atmosphere, and has contributed to research in different directions.

The United States national museum, as has been stated, is at present under the administration of the Smithsonian institution, but is supported by an annual government grant of somewhat over \$200,000. The museum began with Smithson's cabinet of minerals and various miscellaneous collections housed in the patent office, and has grown by collections made under different government bureaus and by gifts. It is inadequately exhibited in a building that cost only \$250,000, and, while containing much of value, is by no means equal to the national museums of Europe. Under the administration of G. Brown Goode, assistant secretary of the Smithsonian institution, the organization was greatly improved. At present it contains three main departments, anthropology, biology and geology.

The American museum of natural history, incorporated in 1869, has been provided by the city of New York with a fine building which is being continually enlarged, and about \$100,000 annually is appropriated for maintenance. The museum is administered by a board of trustees who are responsible for the increase of the collections. About \$75,000 is spent yearly for expeditions and collections. The museum includes a department of public instruction which provides frequent and largely attended lectures.

The Brooklyn institute of arts and sciences, first organized in 1823, in addition to an extensive provision for lectures

and popular instruction, has a museum, for which a new building was recently erected.

The Field Columbian museum of Chicago was opened in 1894. It was established through the gifts of Mr. Marshall Field and other citizens of Chicago after the exposition of 1893, from which it received its building and some of its collections. The museum has enjoyed a rapid growth, its various departments of natural history and technology are well established, and it has begun several series of publications contributing to different departments of science.

There is a State museum at Albany, N. Y., but the museums at Washington, New York and Chicago are the only important independent institutions. There are, however, several museums conducted by societies and universities. Of the former the museums of the Academy of natural sciences of Philadelphia, of the Boston society of natural history and of the San Francisco academy of sciences have already been mentioned. Harvard university possesses the most extensive academic museums, including the Museum of comparative zoology, founded by Agassiz, and the Peabody museum of archæology and ethnology. Yale university has in its Peabody museum one of the most important collections of paleontology in the world. The University of Pennsylvania has good archæological and other collections. The recently-established commercial museums of Philadelphia represent a departure new to America, while the Army medical museum at Washington is an important institution, liberally supported by the government.

The United States possesses several of the greatest astronomical observatories of the world. The three most important are associated with universities, but are used exclusively for research, not for instruction. These are the Harvard, Lick and Yerkes observatories. The Harvard observatory, founded in 1843, is especially engaged in photography and astrophysical research. It has a branch near Arequipa, Peru, at an elevation of 8,000 feet, and is affiliated with the Blue Hill meteorological observatory. Professor

E. C. Pickering is the director, and forty assistants take part in the work of the observatory. The Lick observatory, established in 1875 by James Lick on Mount Hamilton, California, is a department of the University of California. Its great telescope (36 inches), at an elevation of 4,449 feet, has led to many important discoveries. Professor James E. Keeler is the present director. The Yerkes observatory of the University of Chicago, situated at Williams Bay, Wis., was opened in 1897. It has the largest refracting telescope (40 inches) so far made, and, under the direction of Professor George E. Hale, promises important work. The United States naval observatory at Washington, established in 1845, and removed to its present fine building in 1893, has charge of the Nautical almanac and the time service, and has carried out research in various directions. There are special observatories at Albany and Geneva, N. Y., and elsewhere, and nearly all the larger universities and many of the small colleges possess observatories. Among the more active of these are those at Princeton, Allegheny, Madison and Philadelphia.

There is no evident reason why there should not be in the United States great physical and chemical laboratories corresponding to the astronomical observatories, independently endowed, affiliated with universities or under the government, but the time for these institutions appears to have not yet come. The United States, however, must follow the example set by Germany and less adequately by Great Britain and France, and the increasing manufactures and commerce of the country will probably lead to a great development of research in pure and applied physics and chemistry during the twentieth century. It should, however, be mentioned that there are under the national government laboratories and divisions engaged in physical and chemical research, in addition to several private laboratories and the well-equipped laboratories of the universities.

The great unexplored regions of the country and the importance of its mining interests led early to the establish-

ment of geological and topographical surveys under the government. The national survey has an extremely efficient organization, and is allowed an annual appropriation of over \$800,000. It co-operates with the surveys established in many of the states, which are also liberally supported.

A botanical garden was begun in Philadelphia by John Bartram in 1728, and is still maintained somewhat as originally planned. A second garden was established in New York city at the beginning of the century by David Hosack, of Columbia university. It became at one time the property of the state, but was not continued. Nearly a hundred years later a great botanical garden has been established in New York city in affiliation with Columbia university. The city has set aside in Bronx park, 250 acres of land—about equal to the area of the Royal botanic gardens at Kew—and liberal sums for construction and equipment have been provided from public funds and by private gifts. The buildings are now being constructed and the grounds laid out under the supervision of the director, Dr. N. L. Britton. The Missouri botanical garden was established at St. Louis in 1889, through a large bequest from Henry Shaw. It possesses over 600 acres, only part of which is required by the garden, while the rest gives an ample endowment. Dr. William Trelease is the director. The garden, which is affiliated with Washington university, issues annual *Reports* and special *Contributions*. In addition to a botanical garden at Buffalo, established in 1897, several universities possess botanical gardens, of which by far the most important are the Botanic garden and Arnold arboretum of Harvard university. There are well-arranged gardens, especially for teaching purposes, at the University of Pennsylvania, at the University of California, at Smith college and at the Michigan agricultural college. Lastly the botanic gardens and the gardens of the U. S. department of agriculture at Washington may be mentioned. A vast amount of important scientific and economic work in botany, forestry and agriculture is carried out under the auspices of the department,

and plans are being made for the establishment of great botanical gardens at Washington.

The Zoological society of Philadelphia began the construction of a zoological garden in Fairmount park in 1872; the collection of animals has been the best in the United States, and scientific research has not been neglected. In 1874 a flourishing zoological garden was established in Cincinnati, and San Francisco, Pittsburg and other cities have recently secured similar foundations. But the most important advance in this direction has been the recent establishment of great zoological parks in Washington and in New York city. The National zoological park was established by act of congress in 1889, was provided with about 166 acres of land and placed under the direction of the Smithsonian institution. The collections are not very extensive, but the large area of the park allows the animals to live under conditions more nearly natural than is usual in zoological gardens. The park is under the scientific direction of Dr. Frank Baker. A menagerie has been maintained in Central park, New York city, since 1860, but one among the notable scientific advances of the city in recent years has been the establishment of a zoological society and the setting aside by the city in 1897 of 261 acres for a zoological park. It is in Bronx park, near the botanical gardens, and is being developed with resources almost unequalled, under the direction of Mr. W. T. Hornaday, with Professor H. F. Osborn of Columbia university as chairman of the executive committee.

Biological laboratories, beginning with Louis Agassiz's school at Penikese have enjoyed an important development in the United States. These are maintained during the summer, usually in affiliation with a university, and like the university combine research with instruction. The Marine biological laboratory at Woods Holl, Mass., was incorporated in 1888, and under the direction of Dr. C. O. Whitman has grown continually in size and importance. In the laboratory and in the station of the fish commission at

Woods Holl about 100 investigators are engaged each summer, a larger number of students of biology, probably, than will be found elsewhere in the world. Courses of instruction are also given. There are well-organized marine laboratories at Cold Spring Harbor, Long Island, and on the Bay of Monterey, California. The former is administered by the Brooklyn institute of arts and sciences and is under the direction of Dr. Charles B. Davenport. The latter is part of Stanford university and is directed by members of its faculty. There are at least three important freshwater biological stations conducted, respectively, by the University of Indiana, the University of Illinois and the Ohio state university. Numerous special laboratories have also been established, including stations in Bermuda and the Bahamas.

The establishment of a national board of health has often been recommended, but has not as yet been carried into effect. There are, however, numerous state and local boards which carry on important statistical and experimental investigations. We have as yet no well-endowed institutes of pathology or bacteriology, but special laboratories are being founded in connection with municipalities, hospitals and universities. A pathological laboratory has been established for New York state, and it may be expected that the near future will witness a great increase in institutes of experimental and preventative medicine.

There is no previous publication covering the ground of this monograph and in its preparation I have been especially indebted to the officers of societies and institutions who have supplied the information needed. The most useful publications of a general character have been: "Preliminary list of American learned and educational societies," in the report of the commissioner of education for 1893-94; "Catalogue of scientific and technical periodicals," by Dr. H. Carrington Bolton, published by the Smithsonian institution; and "Minerva, Jahrbuch der gelehrten Welt," published at Strasburg.

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